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ABSTRACT

Agricultural commerce on inland waterways has experienced rapid growth in recent years. Major inland movements of agricultural commodities are identified. Effects of pricing and seasonality peculiar to agricultural traffic are examined. Factors contributing to growth of agricultural shipments are analyzed. Finally, policy issues which could impact upon the future of agricultural transportation by waterway are discussed.

Keywords: Agricultural products, capacity, exports, inland waterways, policy issues, production, traffic, transportation.

CONTENTS

Cover photograph and map on p. 4 courtesy of the American Waterways Operators, Inc., Arlington, Va.

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SUMMARY

Inland waterways have contributed substantially to domestic movement of agricultural commodities. Barge shipments of major grains increased over 172 percent from 1960 to 1974.

To accomodate this and other traffic increases, barge capacity and towboat horsepower rose 87 and 73 percent, respectively, during 1963-75. In addition, there has been continual expansion and improvement of waterways by increasing operating water depths and modernizing locks and dams on heavily used waterways.

The Mississippi River system leads all other inland waterways in transportation of farm inputs, grain, and soybeans. In 1973-75, traffic originating on the Mississippi accounted for more than three-fifths of the soybeans and wheat and almost three-fifths of the corn that moved by barge.

Important grain-shipping areas include Minnesota, Wisconsin, Iowa, and Illinois, and the St. Louis and Memphis areas on the Mississippi. Northern Illinois and southern Wisconsin on the Illinois River are others. The Snake River flowing through Oregon, Washington, and Idaho has become an important water route for wheat shipments as well.

Receiving areas for grain and soybeans are concentrated in two locations. During 1970-74, more than 90 percent of the corn and soybeans transported by barge was received in the Baton Rouge-New Orleans, Louisiana, area--primarily for export. The Vancouver, Washington, and Willamette-Yamhill Rivers in Oregon received 43 percent of the total wheat barged on inland waterways. The Tennessee River is also an important domestic receiving area for grains and soybeans.

Total domestic barge shipments of fertilizer increased 115 percent from 1966 to 1974. Phosphate rock and nitrogenous chemicals shipments contributed greatly to the increase.

Major shipping areas are centered on the Gulf Coast at Galveston Bay, Texas, and Mobile Bay, Alabama, and the Lower Mississippi at Baton Rouge and New Orleans. Strategic receiving areas include: all major areas on the Mississippi, particularly Baton Rouge-New Orleans, on the Lower Mississippi; and Minnesota, Wisconsin, Iowa, and Illinois on the Upper Mississippi, as well as the Illinois River.

In addition to technological innovations in waterway equipment and improvement of facilities, the primary factors behind the growth in agricultural barge traffic have been the sharp rise in grain exports and the concentration of grain production in areas accessible to waterways. Also contributing to this growth has been the rise in total U.S. fertilizer consumption, with the majority consumed in the Midwest grain-producing areas.

Inland waterway carriers appear to have a relative ton-mile cost advantage over most competing modes, primarily because of lower operating costs, long hauls, and no fixed capital investments in rights-of-way. Circuitous routing of waterway traffic diminishes some of this advantage, however.

The generally lower cost advantages, coupled with technological advances and the freedom to vary charges on bulk traffic, make inland water carriers a vital link in the movement of agricultural products.

While railroads favor user charges on inland water carriers, the waterway industry claims that significant loss of traffic would occur and that shippers and producers would face losses through increased transportation costs. Proportional allocation of

maintenance, operation, and rehabilitation has shown that agriculture's share exceeds $39 million annually. A more precise estimate is not now available.

Locks and Dam 26 on the Upper Mississippi River have recently caused long and expensive tieups of barge traffic. The facility needs extensive repair but proposals to construct a new and larger lock and dam have met opposition by environmentalists and railroads. In 1974, almost one-half of the traffic passing through Locks and Dam 26 was agricultural products and supplies. It is estimated that the locks will reach maximum capacity by 1982. The outcome of this important link is being debated in the Congress.

WATER CARRIERS AND INLAND WATERWAYS IN AGRICULTURAL TRANSPORTATION

by

Floyd D. Gaibler, Agricultural Economist
National Economic Analysis Division

IMPORTANCE OF WATERWAY TRAFFIC TRANSPORTATION

The Nation's inland waterways have played an important role in domestic commerce since the early 19th century. In recent years, they have accounted for 13 percent of the total net intercity tonnage transported in the United States (table 1). Total ton-miles of freight traffic increased over 55 percent during 1960-75; inland waterway traffic nearly doubled from 124 billion to 243 billion ton-miles. The gain in traffic increased waterway's share of total ton-miles from 9 to almost 12 percent during the period.

In 1975, farm products, primarily grains and soybeans, accounted for 8 percent of total domestic barge traffic. Barge shipments of grains and soybeans increased 184 percent from 1960 to 1975 (table 2). Corn shipments experienced the largest gain--337 percent--increasing from 4.7 million tons in 1960 to 20.5 million in 1975. Soybean shipments increased over threefold; wheat shipments increased 68 percent. Shipments of other grains (grain sorghum, oats, barley, and rye) declined more than 77 percent.

THE WATERWAY SYSTEM

Waterway Capacity

The United States has more than 25,500 miles of inland rivers and canals that are considered commercially navigable (table 3). Of the total, nearly 15,700 miles, or 61 percent, are 9 feet deep or more--the standard operating depth--and about 9,900 miles are less than 9 feet deep.

The Mississippi River system accounts for 35 percent of the total inland waterway system. Almost two-thirds of its 9,000 miles are 9 feet or more in depth. Its depth allows it to be the most intensively used U.S. domestic waterway (fig. 1). Except for the Upper Mississippi (Minneapolis, Minnesota, to mouth of Missouri), the river is open year-round; the Upper Mississippi is closed by ice about 4 months per year, from late December to mid-April. Flooding occasionally causes barging to halt for brief periods.

The Mississippi River system has 30 locks and dams; 27 in the upper river. Winter freezing, spring flooding, and summer heat cause wide variations in water flows, but the dams help stabilize depth for navigation. Navigation locks, which range from 66 to 110 feet in width and from 400 to 1,200 feet in length, allow traffic to move from

Table 1--Estimated intercity freight traffic, by mode, selected years, 1960-75

Item	1960		1965		1970		1971		1972		1973		1974		1975	
	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.	Mil.	Pct.
Net tons:																
Railways	1,241	45.0	1,388	42.4	1,485	41.5	1,391	39.5	1,448	38.6	1,532	38.6	1,543	38.9	1,476	39.5
Motor trucks 1/	276	10.0	419	12.8	596	16.6	625	17.7	684	18.2	756	19.0	2/693	17.5	750	20.1
Great Lakes 3/	155	5.6	154	4.7	157	4.4	141	4.0	145	3.9	157	4.0	146	3.7	129	3.5
Inland waterways	395	14.3	472	14.4	553	15.4	560	15.9	597	15.9	596	15.0	599	15.1	497	13.3
Pipelines	692	25.1	839	25.7	790	22.1	806	22.9	876	23.4	931	23.4	986	24.9	879	23.6
Total	2,759		3,272		3,581		3,523		3,750		3,972		3,967		3,731	
	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.	Bil.	Pct.
Ton-miles:																
Railways	575	43.4	709	42.6	771	40.6	746	38.9	784	38.6	860	39.5	853	38.6	757	36.9
Motor trucks	299	22.5	359	23.3	412	21.7	445	23.2	470	23.1	505	23.2	2/495	22.4	443	21.6
Great Lakes	99	7.5	110	6.6	79	4.2	70	3.7	73	3.6	84	3.9	107	4.8	99	4.8
Inland waterways	124	9.4	153	9.2	204	10.8	210	11.0	230	11.3	232	10.7	247	11.2	243	11.8
Pipelines	229	17.2	306	18.3	431	22.7	444	23.2	476	23.4	495	22.8	506	22.9	512	24.9
Total	1,326		1,637		1,897		1,915		2,033		2,176		2,208		2,054	

1/ Tons of revenue carried in intercity service by class I and II carriers.
2/ Change in definition of class I and II carriers.
3/ Includes tonnage carried in lakewise trade on Great Lakes only.

Source: Annual Reports, Transport Economics and Transport Statistics in the U.S., Interstate Commerce Commission.

Table 2--Domestic barge shipments, selected farm commodities, 1960-75 1/

Year	Corn	Soybeans	Wheat	Other 2/	Total
			1,000 tons		
1960	4,675	2,276	5,138	1,523	13,612
1962	7,251	2,908	5,812	1,120	17,091
1964	9,055	3,426	6,948	988	20,417
1966	11,730	4,057	6,499	586	22,872
1968	11,954	5,692	5,984	1,181	24,811
1970	11,701	8,263	5,778	676	26,418
1972	16,394	8,987	7,807	1,517	34,705
1974	18,116	10,151	8,055	713	37,035
1975	20,447	9,246	8,620	345	38,658
			Percent		
Percentage change 1960-75	337	306	68	-77	184

1/ Includes internal, coastwise, lakewise, local and intraterritory traffic.
2/ Other includes sorghum grains, oats, barley, and rye.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S. CY 1960-1975, part 5, National Summaries, section 1, table 2.

Table 3--Commercially navigable waterways of the United States, by depths, 1974 1/

Waterway system	Depth				Percentage by system
	Under 6 ft.	6 to 9 ft.	9 ft. and over	Total	
			Miles		Percent
Atlantic Coast	1,426	1,241	3,103	5,770	23
Atlantic Intracoastal (Norfolk, Va., to Key West, Fla.)	--	65	1,169	1,234	5
Gulf Coast Waterways	2,055	647	1,590	4,292	17
Gulf Intracoastal (St. Marks, Fla., to Mexican border)	--	--	1,137	1,137	4
Mississippi River system	2,020	969	5,965	8,954	35
Pacific Coast waterways	730	498	2,347	3,575	14
Great Lakes	45	89	356	490	2
All other	76	7	8	91	2/
All waterways	6,352	3,516	15,675	25,543	100

1/ Mileage represents all commercially navigable channels of the United States.
2/ Less than 0.05 percent.

Source: American Waterways Operators, Inc., Inland Waterborne Commerce Statistics, 1974, Washington, D.C.

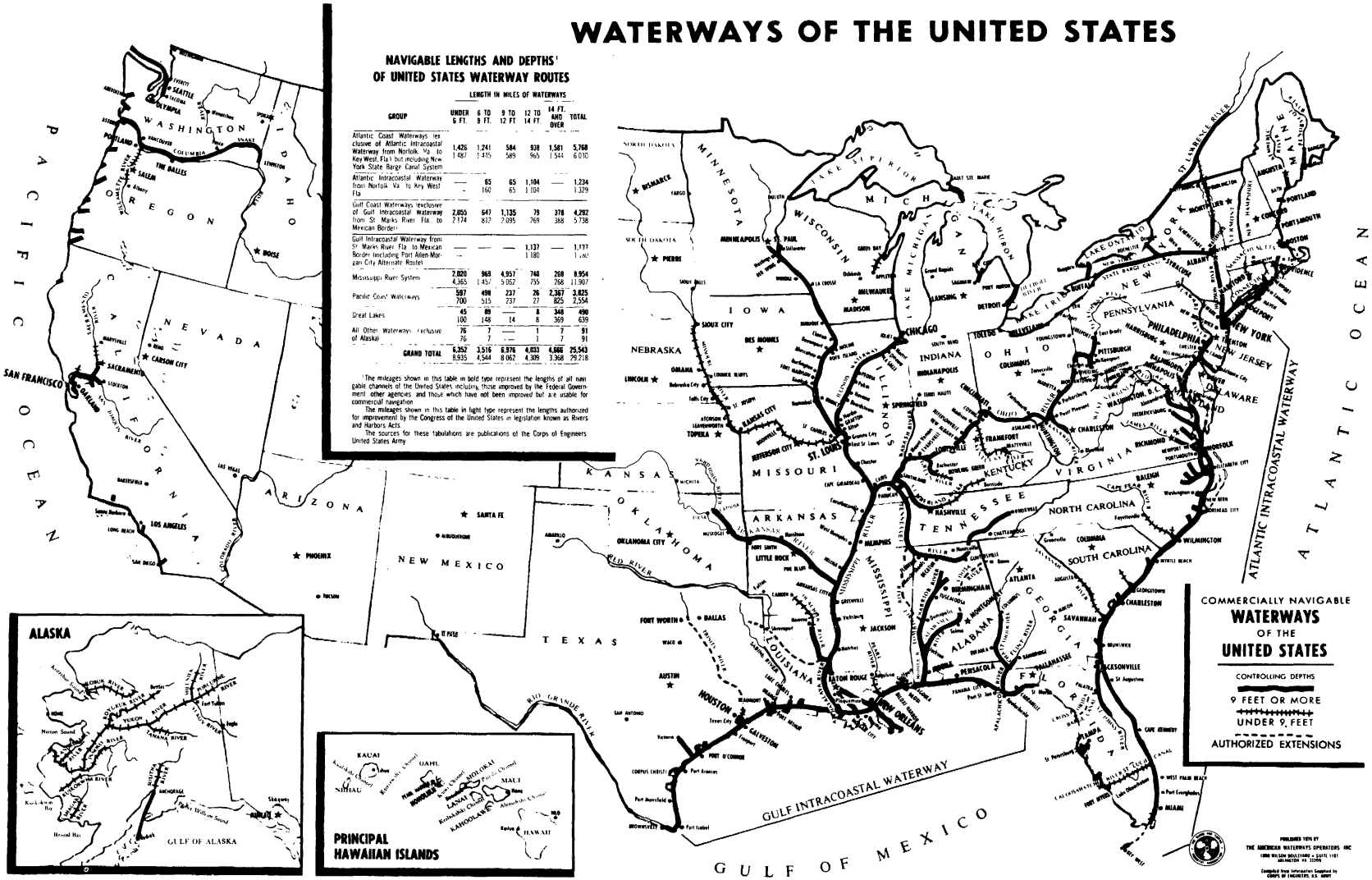
WATERWAYS OF THE UNITED STATES
NAVIGABLE LENGTHS AND DEPTHS' OF UNITED STATES WATERWAY ROUTES
LENGTH IN MILES OF WATERWAYS
GROUP | UNDER 6 FT. | 6 TO 9 FT. | 9 TO 12 FT | 12 TO 14 FT. | 14 FT. AND OVER | TOTAL
Atlantic Coast Waterways (exclusive of Atlantic Intracoastal Waterway from Norfolk, Va. to Key West, Fla.) but including New York State Barge Canal System | 1,426 1,487 | 1,241 1,315 | 584 589 | 938 965 | 1,581 1,544 | 5,768 6,010
Atlantic Intracoastal Waterway from Norfolk, Va. to Key West Fla. | — — | 65 160 | 65 65 | 1,104 1,104 | — — | 1,234 1,329
Gulf Coast Waterways (exclusive of Gulf Intracoastal Waterway from St. Marks River, Fla. to Mexican Border) | 2,055 2,174 | 647 817 | 1,135 2,095 | 78 769 | 378 388 | 4,292 5,738
Gulf Intracoastal Waterway from St. Marks River, Fla. to Mexican Border including Port Allen-Morgan City Alternate Route | — — | — — | — — | 1,137 1,180 | — — | 1,137 1,180
Mississippi River System | 2,020 4,365 | 969 1,457 | 4,957 5,057 | 748 755 | 268 266 | 8,954 11,907
Pacific Coast Waterways | 597 700 | 498 515 | 237 237 | 26 27 | 2,367 825 | 3,825 2,554
Great Lakes | 45 100 | 89 148 | — 14 | 8 8 | 348 369 | 490 639
All Other Waterways (exclusive of Alaska) | 76 76 | 7 7 | — — | 1 1 | 7 7 | 91 91
GRAND TOTAL | 6,367 8,935 | 3,516 4,544 | 6,976 8,062 | 4,033 4,309 | 4,666 3,368 | 25,543 29,218
The mileages shown in this table in bold type represent the lengths of all navigable channels of the United States including those improved by the Federal Government other agencies and those which have not been improved but are usable for commercial navigation
The mileages shown in this table in light type represent the lengths authorized for improvement by the Congress of the United States in legislation known as Rivers and Harbors Acts
The sources for these tabulations are publications of the Corps of Engineers United States Army
ALASKA
PRINCIPAL HAWAIIAN ISLANDS
COMMERCIALLY NAVIGABLE WATERWAYS OF THE UNITED STATES
CONTROLLING DEPTHS
9 FEET OR MORE
UNDER 9 FEET
AUTHORIZED EXTENSIONS
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
GULF INTRACOASTAL WATERWAY
ATLANTIC INTRACOASTAL WATERWAY
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
ARIZONA
NEW MEXICO
TEXAS
COLORADO
KANSAS
OKLAHOMA
NEBRASKA
SOUTH DAKOTA
NORTH DAKOTA
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
RHODE ISLAND
CONNECTICUT
NEW JERSEY
DELAWARE
MARYLAND
SEATTLE
TACOMA
OLYMPIA
PORTLAND
VANCOUVER
THE DALLES
SALEM
ALBANY
LEWISTON
SPOKANE
BOISE
SAN FRANCISCO
OAKLAND
STOCKTON
SACRAMENTO
MARTINEZ
RENO
CARSON CITY
LAS VEGAS
BAKERSFIELD
LOS ANGELES
LONG BEACH
SAN DIEGO
PHOENIX
TUCSON
SANTA FE
ALBUQUERQUE
EL PASO
AMARILLO
WICHITA
OKLAHOMA CITY
FORT WORTH
DALLAS
WACO
AUSTIN
SAN ANTONIO
HOUSTON
GALVESTON
PORT ARTHUR
BEAUMONT
CORPUS CHRISTI
BROWNSVILLE
RIO GRANDE RIVER
LAKE CHARLES
BATON ROUGE
NEW ORLEANS
LITTLE ROCK
MEMPHIS
JACKSON
VICKSBURG
NASHVILLE
CHATTANOOGA
KNOXVILLE
BIRMINGHAM
MONTGOMERY
MOBILE
PENSACOLA
ATLANTA
SAVANNAH
CHARLESTON
COLUMBIA
WILMINGTON
RALEIGH
NORFOLK
RICHMOND
CHARLESTON
FRANKFORT
LOUISVILLE
CINCINNATI
COLUMBUS
PITTSBURGH
CLEVELAND
TOLEDO
BUFFALO
ROCHESTER
SYRACUSE
ALBANY
PHILADELPHIA
NEW YORK
BOSTON
PORTLAND
PROVIDENCE
HARTFORD
NEW HAVEN
BRIDGEPORT
ERIE
DETROIT
LANSING
GRAND RAPIDS
PORT HURON
MILWAUKEE
GREEN BAY
MADISON
LA CROSSE
DULUTH
MINNEAPOLIS
ST. PAUL
SAULT STE MARIE
CHICAGO
GARY
SOUTH BEND
INDIANAPOLIS
TERRE HAUTE
SPRINGFIELD
PEORIA
ROCK ISLAND
DAVENPORT
DES MOINES
SIOUX CITY
OMAHA
COUNCIL BLUFFS
LINCOLN
KANSAS CITY
ST. LOUIS
JEFFERSON CITY
TOPEKA
BISMARCK
PIERRE
FARGO
ALASKA
GULF OF ALASKA
KAUAI
OAHU
MAUI
KAHOOLAWE
HAWAII
HONOLULU
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FIGURE I

one level to another. The sizes of locks and waterway depths are major factors in determining the sizes of tows and types of vessels used.

Included in the Mississippi River system are three important tributary water routes for agricultural products: the Missouri River, the Illinois Waterway, and the Ohio River. The Missouri River has a controlling minimum depth of 7.5 to 9 feet but no locks and dams. The Illinois Waterway has 7 locks and dams and a controlling depth of 9 to 12 feet. On the Missouri, the navigation season lasts 7½ months; except for some occasional winter icing, the Illinois is open year-round. Controlling depth on the Ohio is 9 feet, achieved with 43 locks and dams. Its navigation season is 12 months. Other important water arterials for agricultural products include the Columbia, Tennessee, Arkansas, and James Rivers. The Columbia River is the major export waterway outlet for grain, particularly wheat, on the Pacific Coast. It has a controlling depth of 7 to 42 feet and 8 locks, and a navigation season of 12 months. The Tennesse and Arkansas Rivers are major arteries feeding into the Mississippi. The Tennessee River consists of 13 locks and dams and has a controlling depth of 11 feet, while the Arkansas has a series of 17 locks and dams and a navigational channel depth of 9 feet. Both rivers are open year-round. The James River in Virginia is free of locks and dams and has a controlling depth of 18 to 35 feet.

Barge Capacity

The hopper barge--the basic unit used in transporting bulk agricultural commodities on inland waterways--is a box, usually doublelined, with the inner skin serving as the cargo hold. Some are open, but waterproofed covers make them usable for grains and fertilizer. Open hoppers and dry, covered cargo barges are the two major types in use for bulk agricultural commodities (2, p. 26). 1/

The open hopper barge, easily accessible and heavily braced to absorb stresses from loading and unloading, is well suited for fertilizer materials. There are three standard sizes of open hopper barges, ranging from 175 to 290 feet in length. Capacity ranges from 1,000 to 3,000 tons. The most popular size is 195 feet in length with a 1,500-ton capacity, or about 5 times its unloaded weight (2, p. 27).

Covered barges protect grains and grain products from the elements. Except for their watertight covers over the cargo hold, they are virtually the same as open barges. The most popular covers are the lift-type and rolling covers. Lift covers can be equipped with several hinges grain hatches so that grain can be loaded and unloaded without removing the covers. Rolling covers are mounted on tracks and can be opened to expose one-half of the cargo hold at a time (2, p. 28).

The two standard sizes of dry covered cargo barges are the 175-and 195-foot versions with the same dimensions and capacities as the open hopper barges of the same lengths. The typical covered barge used for hauling grain is the 195-foot, 1,500-ton capacity size. It can haul as much as 25 conventional boxcars or 15 jumbo hopper railcars.

Total net capacity for dry cargo barges and scows in the United States increased more than 88 percent during 1963-75 (table 4). The average net capacity increased 24 percent, from 939 tons in 1963 to 1,167 tons in 1975. During those years, total net capacity of tank barges grew 84 percent. Changes in design have increased barge capacities, and the development of more efficient and powerful towboats and tugboats has allowed operators to transport larger tonnages.

1/ Underscored numbers in parentheses indicate references cited at the end of the report.

Table 4--Inland towing vessels and barges in the United States, alternate years, 1963-75

Year	Type of vessel								
	Towboats and tugs		Nonself-propelled						
			Dry cargo barges and scows			Tank barges		Total	
	Number	Horsepower	Number	Average net capacity	Total net capacity	Number	Total net capacity	Number	Total net capacity
		1,000		Tons	1,000 tons		1,000 tons		1,000 tons
1963	4,205	2,935	14,415	939	13,541	2,739	4,464	17,154	18,005
1965	4,054	2,980	14,241	1,026	14,608	2,548	4,946	16,789	19,554
1967	4,395	3,546	15,830	1,015	16,066	2,781	5,120	18,611	21,186
1969	4,248	3,859	15,890	1,114	17,695	3,281	6,333	19,171	24,028
1971	4,059	4,217	17,527	1,142	19,711	3,420	7,487	20,947	27,198
1973	4,035	4,621	19,772	1,145	22,647	3,375	7,624	23,147	30,271
1975 1/	4,100	5,088	21,876	1,167	25,526	3,534	8,202	25,410	33,728
					Percent				
Percentage change 1963-75	-2.5	73.4	51.8	24.3	88.5	29.0	83.7	48.1	87.3

1/ As of January 1, 1975.

Source: American Waterways Operators, Inc., Inland Waterborne Commerce Statistics, 1969, 1973, and 1975, Washington, D.C.

Towboat Capacity and Tow Sizes

While the actual number of towboats and tugboats decreased during 1963-75, the total net horsepower increased more than 73 percent. More powerful and efficient towboats and tugboats, many in the 5,000-6,000 horsepower range, are being built to replace smaller units. Towboats of 6,000 horsepower and up are capable of pushing barges with cargo capacities ranging from 40,000 to 50,000 tons.

The size of tows is restricted by water depths and the dimensions of waterway locks and dams. A uniform depth of at least 9 feet must be maintained to allow several barges to move together as one unit. On major rivers such as the Upper Mississippi, Ohio, Illinois, and Arkansas, most locks are 110 feet wide and 600 feet long. These dimensions allow single-time locking of tows of twelve 175-foot barges or six 195-foot barges with 12,000 and 9,000 tons of cargo capacity, respectively. Some tows are disassembled before and rejoined after locking, but this is expensive. Typically, as tows proceed downstream, more barges are added, especially when hauling grains. As the size of the tow increases, larger towboats, usually 5,000 horsepower or more, are used to accomodate the increase. For instance, south of the St. Louis, the Mississippi is an open river free of locks and dams and tows of 30 to 35 barges are common. Combinations often include barges of 35-175 feet, 30-195 feet, or 16-290 feet with potential cargo capacities of 35,000, 45,000, and 48,000 tons, respectively. These tows can transport 1.0 to 1.7 million bushels of grain, depending on the density of the commodity. A tow of 35 barges, 175 feet in length (35,000 tons), can transport about the same volume of cargo as three 100-car unit trains assembled with 100 net tons per car, 1,440 average semi-tractor trailers, or a bulk ship in the 30,000-39,999 gross ton range.

Nearly three-fifths of all towboats and tugboats and four-fifths of the available net cargo capacity of dry cargo barges and scows in the United States were operated on the Mississippi River system and the Gulf Intracoastal Waterway in 1974.

The Regulatory Climate and Pricing

Economic regulation of water carriers is very limited compared with regulations for other modes of transport. In 1973, only 16 percent of total intercity freight traffic of water carriers came under Federal regulation. In comparison, 100 percent of railroad freight traffic, 43 percent of motor truck freight, and 85 percent of pipeline traffic was regulated (6, p. 9).

From 1966 to 1974, exempt for-hire water carriers' share of the total ton-miles of agricultural products carried by inland water carriers averaged 82 percent, as calculated from data in table 5. Regulated carriers transported an average of 12 percent and private shippers, 6 percent. For fertilizer products, exempt carriers averaged 85 percent, regulated carriers averaged 7 percent, and private carriers averaged 8 percent (table 6).

Although regulated carriers' share of total agricultural and fertilizer traffic is small, ton-miles of soybeans and nitrogenous materials transported by regulated carriers increased 200 and 2,900 percent, respectively, over the 9-year period.

The Transportation Act of 1940, while giving the Interstate Commerce Commission (ICC) greater power in prescribing rates for transporting commodities by water, did provide an exemption for water carriage of dry and liquid bulk commodities. Grains and fertilizer products fall into this category. Exempt for-hire and private carriers which transport most of the exempt agricultural and fertilizer products do not require Federal authorization or supervision to operate.

These carriers are not required to publish their rates nor do they need approval for rate changes. Thus, they are able to vary rates seasonally to reflect changes in

Table 5 --Domestic ton-miles of major agricultural products, by class of water carrier, 1966, 1970, and 1974

Year and class of carrier	Commodity							
	Corn		Soybeans		Wheat		Other 1/	
	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.
1966:								
Regulated	1.6	11.9	0.4	11.1	0.6	10.3	0.1	8.7
Exempt for-hire	11.2	82.9	2.6	72.2	4.9	84.5	1.0	87.6
Private	.7	5.2	.6	16.7	.3	5.2	.05	4.3
Total	13.5	100.0	3.6	100.0	5.8	100.0	1.1	100.0
1970:								
Regulated	1.1	7.5	.7	8.4	.5	10.8	.12	11.1
Exempt for-hire	12.8	87.7	6.9	83.2	4.0	87.0	.90	83.3
Private	.7	4.8	.7	8.4	.1	2.2	.06	5.6
Total	14.6	100.0	8.3	100.0	4.6	100.0	1.1	100.0
1974:								
Regulated	2.8	11.9	1.2	12.2	1.1	15.1	.17	23.9
Exempt for-hire	20.0	85.5	7.8	79.6	5.9	80.8	.53	74.6
Private	.6	2.6	.8	8.2	.3	4.1	.01	1.5
Total	23.5	100.0	9.8	100.0	7.3	100.0	.7	100.0

Note: Percentages may not add to 100 because of rounding.
1/ Other includes grain sorghum, oats, barley, and rye.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., CY 1966, 1970, and 1974, part 5, National Summaries, section 3, table 4.

Table 6 --Domestic ton-miles of major fertilizer products, by class of water carrier, 1966, 1970, and 1974

Year and class of carrier	Commodity							
	Phosphate rock		Nitrogenous materials		Phosphate and potassic chemicals		Other fertilizer and materials	
	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.	Bil. ton-miles	Pct.
1966:								
Regulated	0.5	12.1	0.01	6.7	.05	2.6	0.06	12.7
Exempt-for hire	3.6	87.4	.10	66.7	1.9	96.9	.41	86.7
Private	.02	0.5	.04	26.6	.01	0.5	.003	.6
Total	4.2	100.0	.15	100.0	1.9	100.0	.47	100.0
1970:								
Regulated	.8	15.3	.07	3.7	.09	6.5	.06	2.3
Exempt for-hire	4.4	83.9	1.4	74.9	1.0	71.9	2.3	89.9
Private	.04	.8	.4	21.4	.3	21.6	.2	7.8
Total	5.3	100.0	1.9	100.0	1.4	100.0	2.6	100.0
1974:								
Regulated	.2	3.1	.3	14.3	.01	1.8	.1	4.2
Exempt for-hire	6.2	96.7	1.7	80.9	.5	89.3	2.2	92.8
Private	.02	.2	.1	4.8	.05	8.9	.07	3.0
Total	6.4	100.0	2.1	100.0	.6	100.0	2.4	100.0

Note: Percentages may not add to 100 because of rounding.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., CY 1966, 1970, and 1974, part 5, National Summaries, section 3, table 4.

supply and demand in their service areas. This creates an incentive for shippers to adjust their services to offset the usual peak and slack seasons that otherwise occur in the demand for transport services, especially for grains and fertilizers.

Grain shippers on inland waterways frequently negotiate exempt barge rates as differentials from an industry rate standard. The standard is taken from the Bulk Grain and Grain Products Freight Tariff No. 7, issued by the Waterways Freight Bureau. The tariff specifies certain rules and regulations concerning diversion and reconsignment of freight, holding freight in transit for orders of owners, minimum weights, loading times, and demurrage charges.

The actual shipping rates charged are not published in tariff schedules. Exempt rates reportedly are often determined as premiums or discounts from the tariff rates. The actual rates fluctuate with changing supply and demand conditions. The primary factors probably responsible include: seasonality, availability of equipment, loading and unloading times, and backhaul load availability, among others. An analysis of rates charged for grain shipments in 1970 revealed wide monthly fluctuations, primarily discounts (14, III-A, 12-14). Generally, the smallest discounts (highest rates) occurred in early spring and late fall months. The peak discounts were experienced in the summer months. The ranges also varied among waterway systems. Although specific origin-destination pairs indicated variations of up to 200 percent, average monthly rates varied only 5 to 20 percent (discounts) from the tariff rates.

AGRICULTURAL TRAFFIC PATTERNS FOR WATERWAY SYSTEMS

Grains and Soybeans

Patterns of grain and soybean movements on the inland waterway network for 1970, 1972, and 1974 are shown in tables 7-9. The tables show only primary origin-destination pairs for traffic on various river systems identified in reports of the U.S. Army Corps of Engineers. Therefore, not all barge movements from each shipping area are included in the commodity totals. Except for wheat and other grains, the included shipping areas accounted for 80 percent or more of the total grain transported by barge from all shipping areas in 1970 (table 7).

The Mississippi and Illinois Rivers are the principal inland waterways for barging grains and soybeans. Much of the surge in export demand for these commodities beginning in 1973 was accommodated by barge traffic on the Mississippi and Illinois systems. From 1973 to 1975, total barge shipments of wheat increased more than 188 percent. In the same period, corn and soybean shipments grew by 11 and 34 percent, respectively. For the 1973-75 marketing years, about three-fifths of the wheat and soybeans and nearly half of the corn shipments by barge originated on the Mississippi. The Illinois River accounted for nearly one-half of the corn and one-fourth of the soybeans shipped on inland waterways (table 10).

The Mississippi serves more important shipping areas than any other of the rivers in the network. The Upper Mississippi shipping area extends from the mouth of the Missouri River to Minneapolis, Minnesota. It is 66 miles long and touches Illinois, Iowa, Minnesota, and Wisconsin. In 1974, almost two-thirds of the grain and soybean traffic originating on the Upper Mississippi was transported to the Baton Rouge-New Orleans, Louisiana, area. Corn shipments jumped 138 percent, from 2.6 million tons in 1970 to 6.2 million tons in 1974. Soybean barge movements increased 31 percent, and those for wheat, 101 percent. Barge shipments of all grains to the Tennessee River area declined: for corn 63 percent; soybeans 54 percent; and wheat 27 percent.

The St. Louis area, approximately 220 miles in length, includes the region from the mouth of the Missouri to the mouth of the Ohio River. From 1970 to 1974, corn shipments

Table 7--Domestic inland movements of grains and soybeans, by major shipping and receiving areas, 1970

Shipping/receiving areas	Corn	Soy-beans	Wheat	Other 1/
		1,000 tons		
Mississippi River:				
From Memphis area to Baton Rouge-New Orleans, La.	75	1,956	290	32
From St. Louis area to Baton Rouge-New Orleans, La.	119	374	67	--
From Minn., Wisc., Iowa, Ill. area to--				
Baton Rouge-New Orleans, La.	2,588	1,748	294	14
Tenn. River, Tenn., Ala., and Ky.	451	112	174	15
Missouri River:				
From Nebr., Iowa, Kansas City area to--				
Baton Rouge-New Orleans, La.	109	176	8	10
Tenn. River, Tenn., Ala., and Ky.	7	--	326	16
Illinois River:				
From northern Ill. and southern Wisconsin to--				
Baton Rouge-New Orleans, La.	5,577	2,019	335	28
Tenn. River, Tenn., Ala., and Ky.	1,053	263	51	39
Ohio River:				
From Louisville Engineer District to Baton Rouge-New Orleans, La.	123	186	7	2
Columbia River:				
From Celilo Falls-Kennewick, Wash. to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	634	34
Willamette and Yamhill Rivers, Ore.	--	--	238	7
Snake River:				
From Ore., Wash., and Idaho to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	115	3
Willamette and Yamhill Rivers, Ore.	--	--	482	4
Total	10,101	6,833	3,019	203
		Percent		
Percent of total U.S. shipping areas	.89	.83	.73	.32

1/ Other includes barley and rye, oats, rice, and sorghum grains.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., CY 1970, part 5, National Summaries, section 2, table 1.

Table 8--Domestic inland movements of grains and soybeans, by major shipping and receiving areas, 1972

Shipping/receiving areas	Corn	Soybeans	Wheat	Other 1/
		1,000 tons		
Mississippi River:				
From Memphis area to Baton Rouge-New Orleans, La.	72	2,003	470	134
From St. Louis area to Baton Rouge-New Orleans, La.	413	565	361	199
From Minn., Wisc., Iowa, Ill. area to--				
Baton Rouge-New Orleans, La.	3,878	1,804	343	150
Tenn. River, Tenn., Ala., and Ky.	187	30	262	20
Missouri River:				
From Nebr., Iowa, Kansas City area to--				
Baton Rouge-New Orleans, La.	19	89	332	221
Tenn. River, Tenn., Ala., and Ky.	--	--	294	--
Illinois River:				
From northern Ill. and southern Wisconsin to--				
Baton Rouge-New Orleans, La.	9,384	2,351	553	199
Tenn. River, Tenn., Ala., and Ky.	637	81	373	68
Ohio River:				
From Louisville Engineer District to Baton Rouge-New Orleans, La.	284	383	169	33
Columbia River:				
From Celilo Falls-Kennewick, Wash. to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	532	6
Willamette and Yamhill Rivers, Ore.	--	--	303	1
Snake River:				
From Ore., Wash., and Idaho to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	517	10
Willamette and Yamhill Rivers, Ore.	--	--	799	3
Total	14,873	7,305	5,570	1,044
		Percent		
Percent of total U.S. shipping areas	.93	.81	.89	.61

1/ Other includes barley and rye, oats, rice, and sorghum grains.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., CY 1972, part 5, National Summaries, section 2, table 1.

Table 9--Domestic inland movements of grains and soybeans, by major shipping and receiving areas, 1974

Shipping/receiving areas	Corn	Soy-beans	Wheat	Other 1/
		1,000 tons		
Mississippi River:				
From Memphis area to Baton Rouge-New Orleans, La.	78	2,454	459	60
From St. Louis area to Baton Rouge-New Orleans, La.	472	626	313	8
From Minn., Wisc., Iowa, Ill. area to--				
Baton Rouge-New Orleans, La.	6,164	2,291	591	10
Tenn. River, Tenn., Ala., and Ky.	165	52	128	5
Missouri River:				
From Nebr., Iowa, Kansas City area to--				
Baton Rouge-New Orleans, La.	241	107	330	--
Tenn. River, Tenn., Ala., and Ky.	60	1	249	--
Illinois River:				
From northern Ill. and southern Wisconsin to--				
Baton Rouge-New Orleans, La.	8,417	2,157	973	26
Tenn. River, Tenn., Ala., and Ky.	432	159	102	58
Ohio River:				
From Louisville Engineer District to Baton Rouge-New Orleans, La.	444	543	272	--
Columbia River:				
From Celilo Falls-Kennewick, Wash. to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	638	14
Willamette and Yamhill Rivers, Ore.	--	--	313	5
Snake River:				
From Ore., Wash., and Idaho to--				
Vancouver, Wash., and Portland, Astoria, Ore.	--	--	434	23
Willamette and Yamhill Rivers, Ore.	--	--	1,128	37
Total	16,474	8,390	5,928	247
		Percent		
Percent of total U.S. shipping areas	.93	.83	.87	.43

1/ Other includes barley and rye, oats, rice, and sorghum grains.

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the U.S., CY 1974, part 5, National Summaries, section 2, table 1.

Table 10--Domestic inland barge movements of grain by rivers, 1973-75

Origin	Wheat			Corn			Soybeans		
	1973	1974	1975	1973	1974	1975	1973	1974	1975
	1,000 tons								
Mississippi River:									
Minnesota-Wisconsin	984	1,776	1,887	4,180	3,730	2,369	717	1,059	477
Iowa & North Ill.	21	72	54	3,352	3,248	3,830	834	1,218	984
St. Louis area	333	678	1,137	837	896	1,481	1,287	1,281	1,413
Memphis area	141	366	564	22	20	56	60	2,004	2,145
Missouri River:									
Nebraska-Iowa	141	60	123	143	213	56	45	51	24
Kansas City area	309	696	534	64	73	6	78	48	48
Illinois River	180	363	633	7,750	6,717	9,747	2,148	1,893	2,061
Ohio River	135	435	642	801	546	1,470	975	837	1,077
Snake and Columbia Rivers	1/--	1/--	897	0	0	0	0	0	0
Total	2,244	4,446	6,471	17,149	15,443	19,015	6,144	8,391	8,229

1/ Data not available.

Source: Grain Market News, Agricultural Marketing Service, USDA.

from this area to the Gulf increased almost four-fold; wheat shipments increased almost five-fold; and soybean shipments gained almost 70 percent.

The Memphis area extends from the mouth of the Ohio to the head of ocean-vessel navigation at, but not including, Baton Rouge, Louisiana. It also includes the Yazoo, Arkansas, White, and Wolf Rivers. Soybean shipments from this area accounted for almost 30 percent of the total soybeans originating from all major shipping areas in 1970. From 1970 to 1974, shipments of soybeans increased 26 percent, wheat shipments gained 58 percent and corn shipments rose 4 percent.

The Missouri River serves the Nebraska, Iowa, and Kansas City area stretching from the South Dakota border to the mouth of the Missouri. Corn shipments to Baton Rouge-New Orleans, Louisiana, gained 120 percent during 1970-74, but soybean shipments dropped steadily, from 176,000 to 107,000 tons. In contrast, wheat movements increased over 40-fold, from 8,000 tons in 1970 to 330,000 tons in 1972 and 1974.

The northern Illinois and southern Wisconsin grain-shipping area includes the Illinois waterway, the Port of Chicago, and the Black and Minnesota Rivers in Wisconsin. During 1970-74, corn and soybean movements between the northern Illinois and southern Wisconsin area and the Baton Rouge-New Orleans, Louisiana, area made only modest gains. But the area originated over one-half of the corn and about 30 percent of the soybeans transported from the major shipping areas during 1970-74. Wheat shipments, in contrast, increased 190 percent between 1970 and 1974. Corn and soybeans received on the Tennessee River from this area dropped 59 and 40 percent, respectively, while wheat shipments rose about 100 percent.

The Ohio River forms in Pennsylvania and borders the Corn Belt States of Ohio, Indiana, and Illinois on the south. It is 981 miles in length. Barge traffic from the Louisville Engineer District on the Ohio to the Baton Rouge-New Orleans, Louisiana area experienced a large upsurge during 1970-74. Corn shipments increased 260 percent, soybeans 192 percent, and wheat over 38-fold--from 7,000 to 272,000 tons.

The Snake River forms in southern Idaho and extends into Washington, where it empties into the Columbia River. Wheat is the only major agricultural commodity transported on the two rivers. Shipments on the two rivers increased over 70 percent, from 1.5 to 2.5 million tons, during 1970-74. The two major receiving areas are Vancouver, Washington, and the junctures of the Willamette and Yamhill Rivers, Oregon.

Of the four major grain receiving areas, three are primarily export points. Grain and soybeans transported on the Tennessee River are used mainly for domestic feeding, milling, and crushing operations.

The Baton Rouge-New Orleans area is foremost among the major exporting points. It received over 90 percent of the corn, 97 percent of the soybeans, and 40 percent of the wheat from identified shipping areas during 1970-74. The other two major exporting points, Vancouver, Washington, and the Willamette and Yamhill Rivers, Oregon, together received about 43 percent of the total wheat barged over the 5-year period.

Fertilizer and Fertilizer Materials

Barge shipments of fertilizer, particularly phosphate rock and nitrogenous chemicals, increased dramatically during 1966-74 (table 11). Phosphate rock and nitrogenous chemicals accounted for almost three-fourths of the total fertilizer shipped by barge toward the end of this period. Phosphate rock shipments more than doubled from 1966 to 1974, but nitrogenous chemical shipments gained most--almost nine-fold--from 227,000 tons in 1966 to nearly 2 million tons in 1974. Much of the phosphate rock is produced in North Carolina and Florida. It is usually transported by ship or an oceangoing barge from Florida to the New Orleans area where it is transferred to river barges for movement to the Upper Mississippi and Illinois Waterways (14, p. III-G 6).

Table 11--Domestic barge shipments, selected fertilizer materials, 1966, 1970, and 1974

Commodity	1966			1970			1974		
	International	Other 1/	Total	International	Other 1/	Total	International	Other 1/	Total
	1,000 tons								
Phosphate rock	571	3,573	4,144	767	5,063	5,830	1,374	7,161	8,535
Nitrogenous chemicals	182	45	227	1,296	531	1,827	1,587	391	1,978
Phosphate chemicals	841	871	1,712	1,045	233	1,278	538	56	594
Potassic chemicals	52	211	263	168	345	513	157	101	258
Other fertilizer and materials	364	83	447	1,938	361	2,301	3,121	132	3,253

1/ Other includes coastwise, lakewise, local, and intraterritory traffic.

Source: U.S. Army Corp of Engineers, Waterborne Commerce of the U.S. CY 1966, 1970 and 1974, part 5, National Summaries, section 1, table 2.

Shipments of phosphatic chemicals decreased sharply--over 65 percent--during the 9-year period. A decline in agricultural consumption of superphosphate, a phosphatic chemical compound, contributed to the decrease.

Potassic chemicals shipments almost doubled from 1966 to 1970, but dropped slightly below the 1966 level in 1974. Other fertilizer and materials increased more than 600 percent.

Domestic inland movements of fertilizer and fertilizer chemicals were divided among 6 shipping areas and 11 receiving areas (table 12). Shipping areas were concentrated in the Gulf Coast (Mobile Bay, Alabama, and Galveston Bay, Texas) and in the Lower Mississippi (Baton Rouge and New Orleans, Louisiana). Less important Atlantic Coast shipping areas were the James River in Virginia, and the Pamlico and Tar Rivers in North Carolina.

Receiving areas include all major regions on the Mississippi and its tributaries, the Missouri, Illinois, Ohio, and the Tennessee Rivers. The areas receiving the largest amounts of fertilizer were Baton Rouge-New Orleans on the Lower Mississippi, Minnesota, Wisconsin, Iowa, and Illinois on the Upper Mississippi and Illinois Rivers. Fertilizer movements may serve as backhauls for grain shipments, since much of the fertilizer shipments terminate in the major grain production regions (2, pp. 94, 116).

On the Atlantic Coast, fertilizer movements from the James River to Hampton Roads, Virginia area increased 25 percent, while those on the Pamlico and Tar Rivers to Wilmington, North Carolina, dropped off from 387,606 tons in 1970 to zero in 1974.

All Gulf Coast fertilizer shipments to major receiving areas increased except those to the Missouri and Illinois Rivers. Traffic from the Mobile, Alabama-New Orleans, Louisiana, area to the Memphis area experienced large growth, increasing 140 percent over the 5-year period.

For the most part, fertilizer traffic on the Mississippi River has continued to increase. The Baton Rouge-New Orleans receiving area has made the largest gain, with shipments increasing 256 percent from 415,000 tons in 1970 to 1.5 million tons in 1974. Fertilizer shipments to the Ohio River increased 153 percent during the same period. Only the St. Louis area had a decline--71 percent--in fertilizer traffic.

On the average, the shipping and receiving areas of the Gulf Coast and the Mississippi accounted for 92 percent of the domestic inland water movements of fertilizer. Total fertilizer and fertilizer materials shipments on inland waterways increased 43 percent from 1970 to 1974.

Table 12--Domestic inland movements of fertilizer, by major shipping and receiving areas, 1970, 1972, and 1974

Shipping/receiving areas	Fertilizer and fertilizer materials 1/		
	1970	1972	1974
	1,000 tons		
Atlantic Coast:			
James River, Va., to Hampton Roads, Va.	102	121	128
Pamlico and Tar River, N.C., to Wilmington, N.C.	388	261	--
Gulf Coast:			
Mobile Bay, Ala.-New Orleans, La., to--			
Memphis area	96	176	230
Tenn. River, Tenn., Ala., and Ky.	49	66	60
Galveston Bay, Tex., to--			
Mobile Bay, Ala.-New Orleans, La.	113	206	148
Memphis area	30	89	33
St. Louis area	54	54	71
Missouri River	30	33	18
Illinois River	118	84	84
Mississippi River:			
Baton Rouge, La., to Baton Rouge-New Orleans, La.	415	1,335	1,478
Baton Rouge-New Orleans area to--			
Galveston-Corpus Christi area	82	117	84
Memphis area	199	373	340
St. Louis area	175	183	50
Minn., Wis., Iowa, Ill.	995	1,121	1,067
Missouri River	277	242	315
Illinois River	689	784	1,173
Ohio River	151	172	382
Total	3,960	5,417	5,660
	Percent		
Percent of U.S. shipping areas	.75	.79	.83

1/ Includes phosphate rock, nitrogenous, phosphatic, potassic chemicals, and other fertilizer and materials.
Source: U.S. Army Corp of Engineers, Waterborne Commerce of the U.S., CY 1970, 1972, and 1974, part 5, National Summaries, section 1, table 6.

Seasonality

Grain harvesting and transportation seasons vary by crop and location. For instance, the wheat harvest begins in the South Central States in May and continues northward into the Dakotas by September. Soybeans and corn are usually harvested during September and October, but some corn is harvested in November and December. Weather, the volume of production, local availability of storage and drying capacity, and demand for exports during the harvest season can modify seasonal demands for transportation.

Figure 2 shows that barge shipments of grain usually peak after the wheat and soybean harvesting season. These peaks occurred consistently during the 1973-75 seasons. A 5-week moving average was employed in the figure to smooth wide fluctuations in amounts of grain shipped from week to week, especially during harvest seasons.

During 1973-75, there were several trends in corn barge shipments (fig. 3). The early April through early May decline in shipments reflects a decrease in the inventories of the previous year's crops. Also contributing to the decline during this period is occasional annual spring flooding on the Upper Mississippi and Missouri Rivers, such as in 1973. The May surge in shipments resulted from market influences such as crop conditions and market demand. The fall shipments reflected the harvest season. An earlier than usual corn harvest in 1975 caused shipments to peak sooner than in the previous 2 crop years.

For wheat, two small peaks usually occurred (fig. 4). They paralleled the winter wheat harvest, which begins in early May, and the spring wheat harvest beginning in August. The significant declines in late December coincide with yearend holidays and freezing on the Upper Mississippi River during the winter months.

Soybean barge shipments experienced only mild flucutations, except for the annual peak at the harvest season and the yearend decline (fig. 5).

Competition for Equipment

The barge industry faces significant intermodal competition as well as intramodal competition among barge lines, especially for grains. Both service and price competition are prevalent. Types of service competition include speed of service, frequency of service, equipment availability, and shipper ownership, and leasing of equipment (14, IV-A. 3-IV-A. 10).

Barges travel much more slowly than either truck or rail. Truck and rail routes are more direct and accessible than inland waterways. However, barges usually transport larger volumes than the competing modes. Average length of haul of grain barged in 1975 was 1,130 miles. Trucks can competitively haul bulk commodities only short distances, except under backhaul arrangements. Railroads typically transport grain over long-haul routes. In 1973, the average rail haul of grain and soybeans was 536 miles.

Timeliness of service, while in part dependent on the speed traveled between points, relies heavily on scheduling of departures to meet shipper needs, especially in peak periods. However, there are times when arrival schedules dictate abrupt revisions in departure schedules and in choices of modes. For example, particular shipments may be required to complete the loading of an ocean vessel destined for a market having specific quality requirements.

Equipment availability is perhaps the most critical factor in intermodal competition. Availability fluctuates with changes in demand for transportation services. Seasonality of grain harvests produce peak and off-peak periods of demand for transportation equipment. Barge rates for hauling exempt bulk commodities can vary with changes in demand. Higher rates (premiums) are charged during peak periods, while lower prices (discounts) usually prevail through the off-season. This encourages shippers to store grain during the harvest period for shipment later at lower rates. The method also provides better utilization of equipment capacity throughout the year. Trucking firms that transport exempt grain also can vary rates with changes in demand. Because railroads are regulated, their rates have not been very flexible. The Railroad Revitalization and Regulatory Reform Act of 1976 attempts to provide for some flexibility. To better utilize equipment, railroads have introduced larger, more efficient railcars and the unit train concept, which offers large volume shipments of grain at lower multiple-car rates; and eliminated or reduced some services to increase turnaround time.

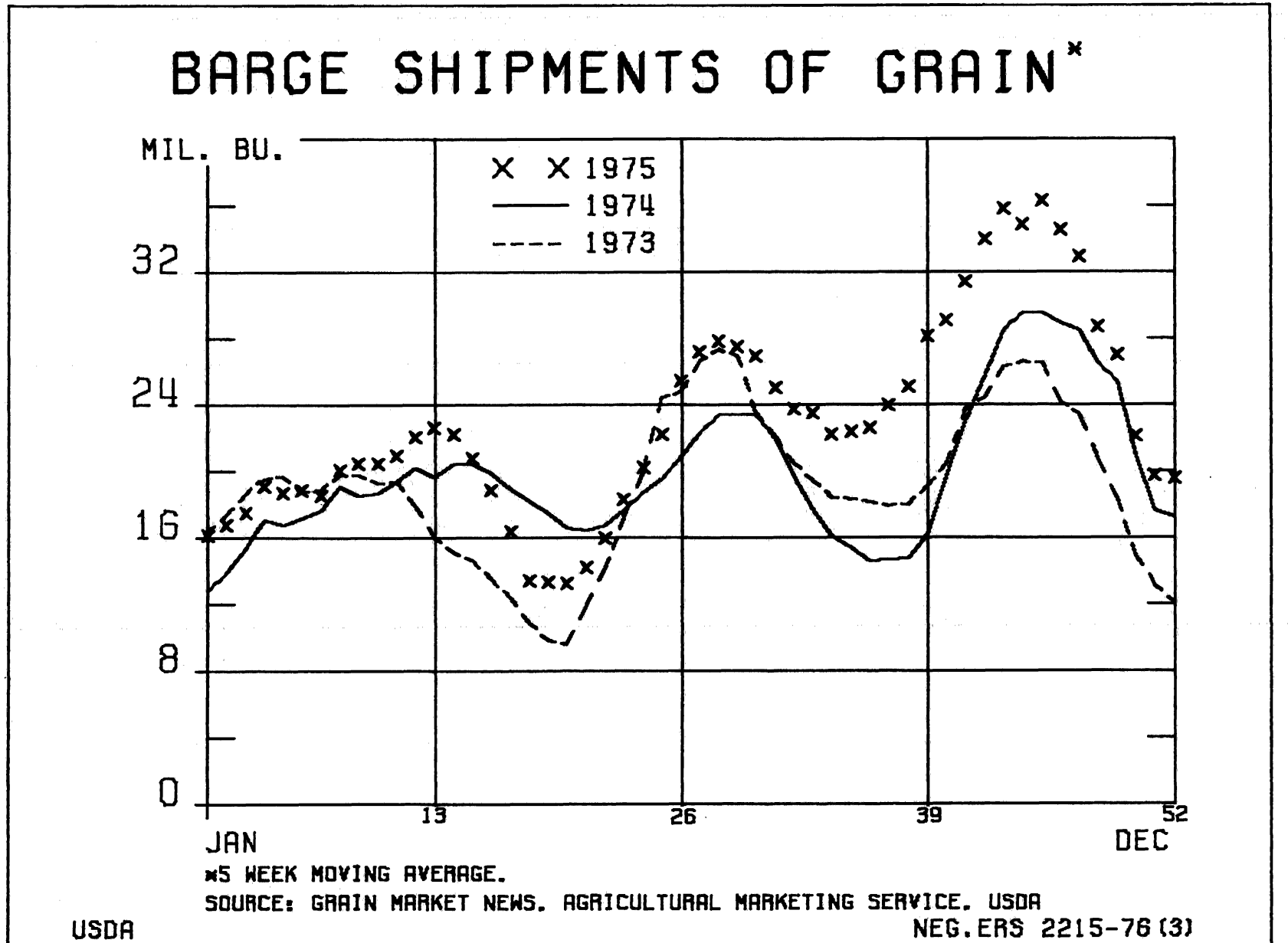
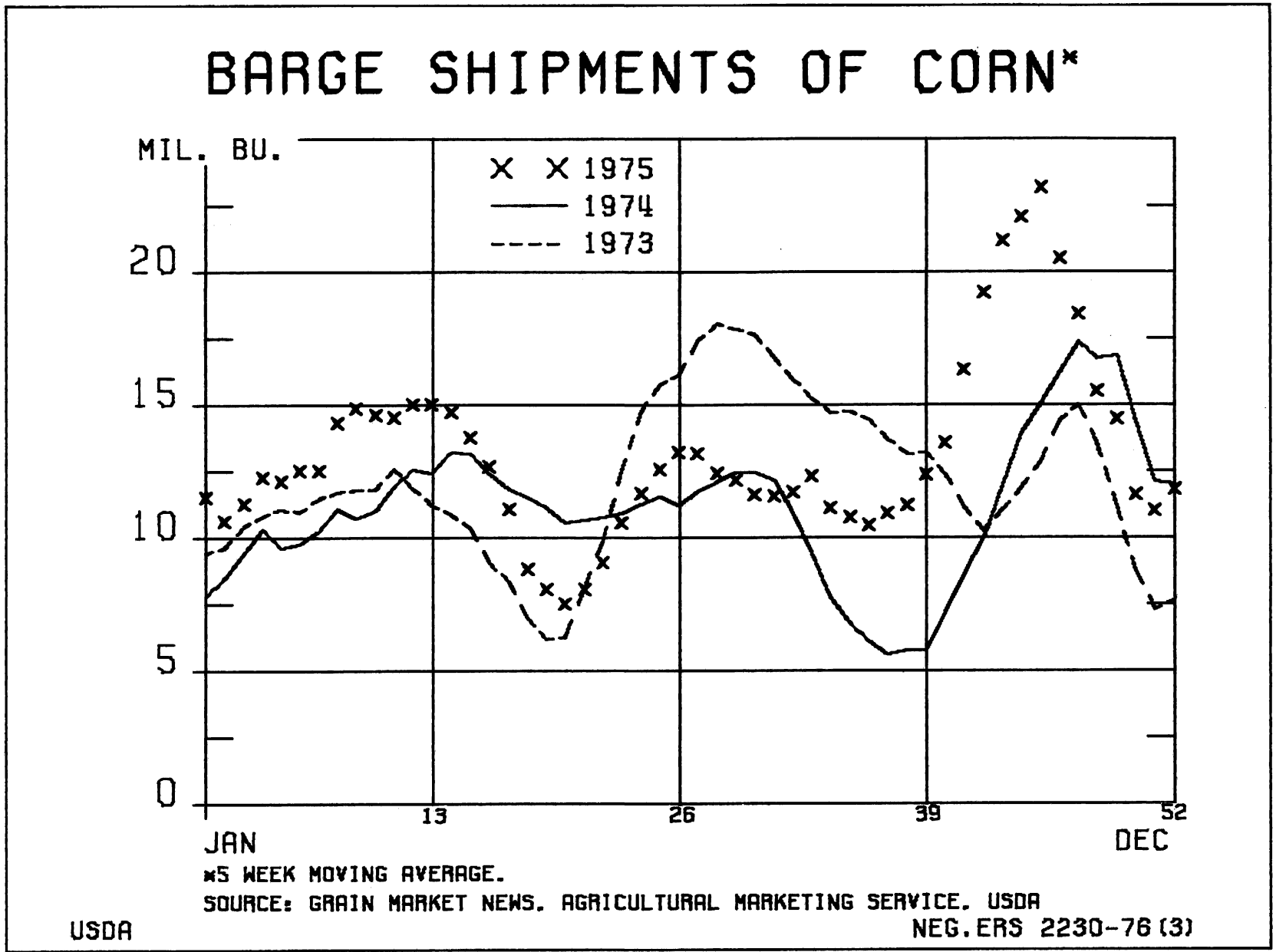

BARGE SHIPMENTS OF GRAIN*
MIL. BU.
1975
1974
1973
32
24
16
8
0
13
26
39
52
JAN
DEC
*5 WEEK MOVING AVERAGE.
SOURCE: GRAIN MARKET NEWS. AGRICULTURAL MARKETING SERVICE. USDA
USDA
NEG. ERS 2215-76 (3)

Figure 2


BARGE SHIPMENTS OF CORN*
MIL. BU.
1975
1974
1973
20
15
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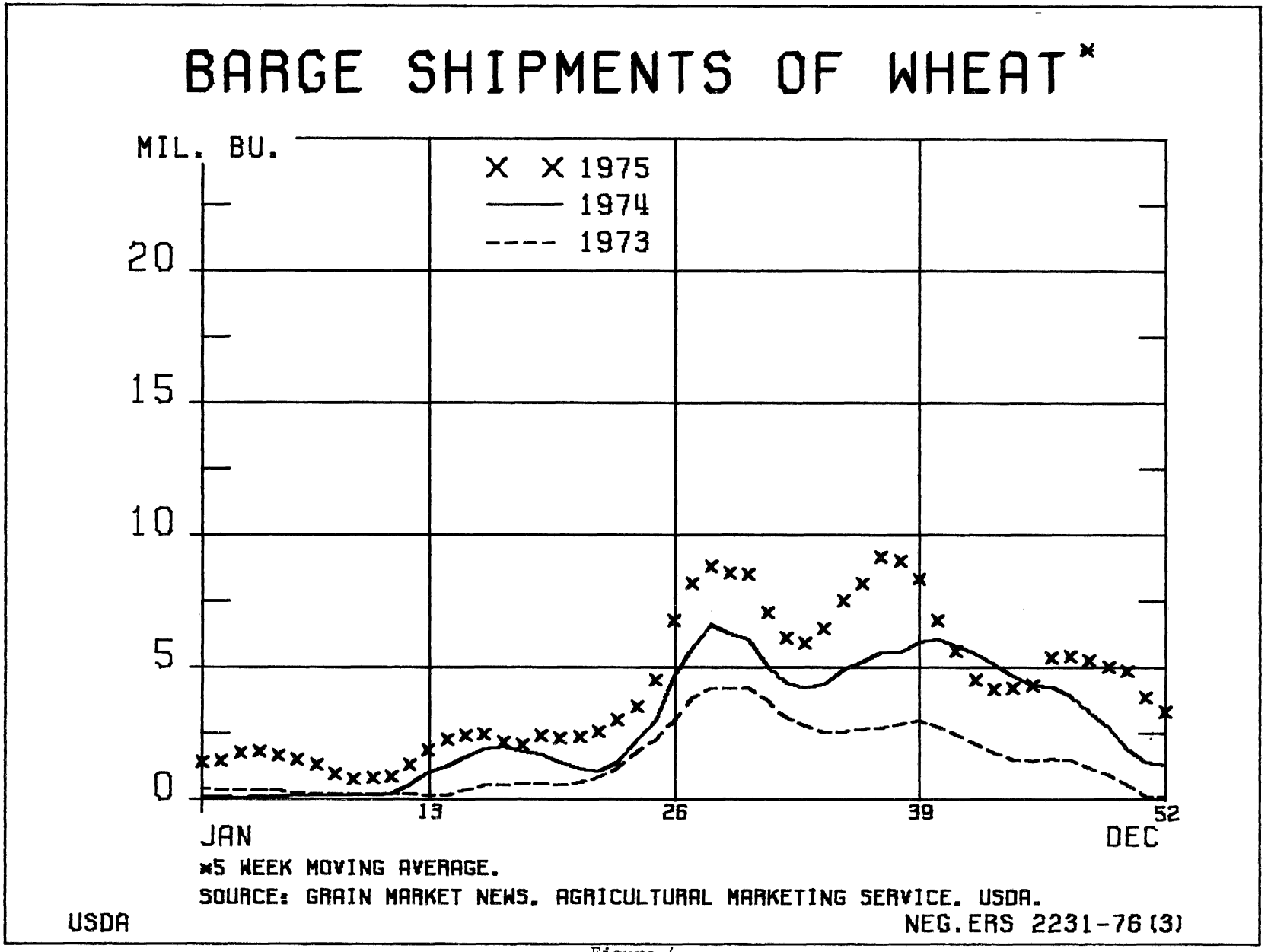
DEC
*5 WEEK MOVING AVERAGE.
SOURCE: GRAIN MARKET NEWS. AGRICULTURAL MARKETING SERVICE. USDA
USDA
NEG.ERS 2230-76 (3)

Figure 3


BARGE SHIPMENTS OF WHEAT*
MIL. BU.
X X 1975
1974
1973
20
15
10
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0
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39
52
JAN
DEC
*5 WEEK MOVING AVERAGE.
SOURCE: GRAIN MARKET NEWS. AGRICULTURAL MARKETING SERVICE. USDA.
USDA
NEG. ERS 2231-76 (3)

Figure 4

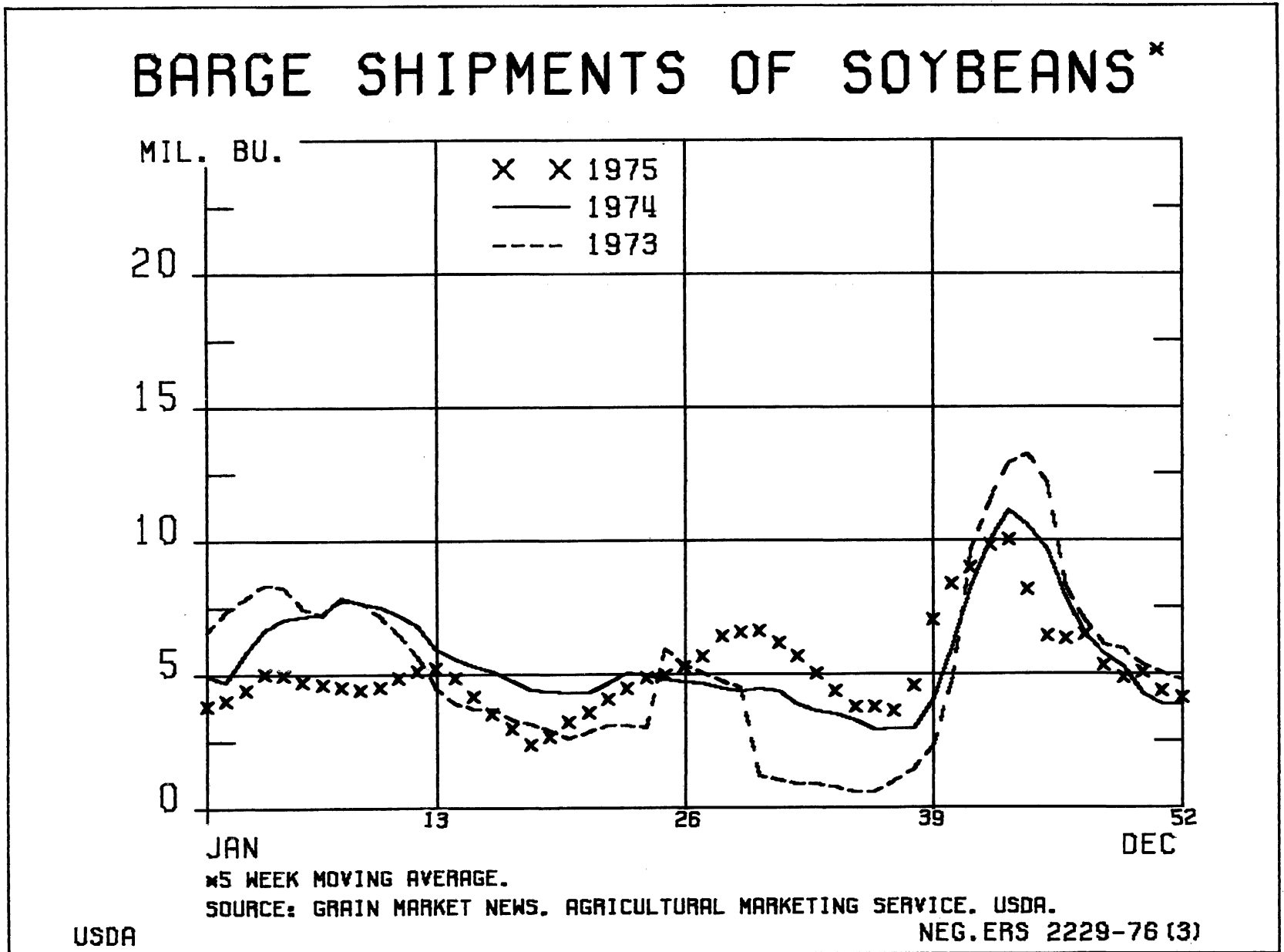
BARGE SHIPMENTS OF SOYBEANS*
MIL. BU.
X X 1975
1974
1973
20
15
10
5
0
13
26
39
52
JAN
DEC
*5 WEEK MOVING AVERAGE.
SOURCE: GRAIN MARKET NEWS. AGRICULTURAL MARKETING SERVICE. USDA.
USDA
NEG.ERS 2229-76(3)

Figure 5

In some instances, shippers own their barges and contract with barge operators for towing service. Others acquire equipment through a lease arrangement. Similar ownership and lease contracts exist in the railroad industry. With these methods, the shipper can more nearly control when and where the shipments are to take place.

To further alleviate the equipment availability problem, some shippers have either built or increased storage capacity at shipping points and/or final destinations.

FACTORS BEHIND AGRICULTURAL TRAFFIC GROWTH

Increases in Exports

The dramatic rise in the level of grain exports, especially during 1973-75, was a major factor in growth of agricultural traffic (table 13).

Table 13--Grain inspection for export, 1960 and 1970-75

Year	Corn	Wheat	Soybeans	Other 1/	Total
			1,000 tons		
1960	6,023	15,009	4,350	5,423	30,805
1970	15,064	19,251	12,996	5,506	52,817
1971	14,095	18,000	12,864	4,607	49,566
1972	24,046	23,511	13,203	5,831	66,591
1973	35,552	43,322	14,358	9,868	103,097
1974	32,273	27,756	15,147	7,823	82,999
1975	36,184	34,275	13,689	7,246	91,394

1/ Other includes grain sorghum, oats, barley, and rye.

Source: U.S. Dept. of Agriculture, Agricultural Marketing Service, Grain Market News, 1960-75.

Corn and soybeans, spurred by increased overseas demand, have experienced the largest gains. During 1960-75 the quantity of corn shipped for export increased 500 percent and soybeans increased 200 percent. Total grain and soybean export shipments rose almost 200 percent during 1960-75.

Receipts of grain and soybeans inspected from all reporting areas under the U.S. Grain Standards Act indicate an approximation of intermodal shares of traffic. From 1969 to 1974, the share transported by barge ranged from 17 to 23 percent (15, p. 77). The share transported by railroads varied from 61 to 69 percent and that by truck fluctuated from 13 to 18 percent.

Regional Concentration of Increased Agricultural Production

The majority of U.S. grain and soybean production occurs in the Midwest. All of the States in this area either border the Mississippi River system and its tributaries or are only a short distance away. Almost 75 percent of the total grain and soybeans sold from U.S. farms in 1974 was located in this area (table 14). A larger part of the total increased production of these commodities from 1972 to 1975 occurred in these water-tributary States.

Table 14--Grain and soybean production sold from farms, selected States, 1974

State	Corn	Soybeans	Wheat	Other 1/	Total
			1,000 bushels		
North Dakota	4.5	2.8	198.2	58.8	264.3
South Dakota	41.5	7.5	54.2	51.0	154.2
Nebraska	281.8	27.8	95.4	63.6	468.4
Kansas	99.9	19.9	308.7	91.8	520.3
Minnesota	194.4	82.6	78.6	65.5	421.1
Wisconsin	52.5	4.1	2.6	14.1	73.3
Iowa	568.8	196.6	1.1	30.4	796.9
Missouri	74.5	93.9	33.9	12.9	215.2
Illinois	598.2	203.5	50.5	12.1	864.3
Indiana	263.6	95.9	46.7	5.6	411.8
Ohio	165.2	78.1	61.4	12.0	316.7
Oklahoma	4.9	4.9	128.3	19.4	157.5
Texas	61.8	7.8	49.1	247.0	365.7
Total	2,411.6	825.4	1,108.7	684.2	5,029.9
United States	2,924.0	1,208.7	1,707.5	923.1	6,763.3

1/ Includes barley, rye, oats, and sorghum grains.

Source: Agricultural Statistics, 1975, U.S. Dept. of Agriculture.

Corn is grown predominantly in the "Corn Belt" States of Iowa, Indiana, and Illinois. These States contributed almost 50 percent of the total U.S. corn sold from farms in 1974. Soybean sales from farms also rank highest in the Corn Belt States along with Minnesota and Missouri. Wheat production, which is concentrated in North Dakota, Nebraska, Kansas, and Oklahoma, accounted for 43 percent of the total 1974 U.S. wheat sold from farms. Grain sorghum-producing areas include Kansas, Oklahoma, and Texas. Barley, oats, and rye production is concentrated in the Dakotas, Minnesota, and Wisconsin.

Increased Use of Fertilizer and Fertilizer Materials

Total U.S. consumption of fertilizers and plant nutrients increased from 24.9 million tons in 1960 to 47.1 million tons in 1974, or by almost 90 percent, (table 15). During the 1966-74 period, consumption increased 36 percent or an annual average gain of 4 percent. Nitrogen showed the largest increase in usage of the three primary nutrients, over 72 percent.

Table 15--U.S. consumption of fertilizer and plant nutrients, 1960 and 1966-74

Year	Total consumption							
	Gross tonnages				Primary nutrient content			
	Mixed fertilizer	Primary nutrient material	Secondary and micro-nutrients	Total	N	Available P_2O_5	K_2O	Total
	1,000 tons							
1960	15,650	7,850	1,380	24,878	2,738	2,572	2,153	7,463
1966	19,659	13,412	1,461	34,532	5,326	3,897	3,221	12,444
1967	21,132	14,552	1,397	37,081	6,027	4,305	3,642	13,974
1968	21,294	15,832	1,617	38,743	6,788	4,453	3,793	15,034
1969	21,234	16,380	1,334	38,949	6,958	4,666	3,892	15,516
1970	20,961	17,331	1,297	39,589	7,459	4,574	4,036	16,069
1971	21,513	18,389	1,216	41,118	8,134	4,804	4,231	17,169
1972	21,511	18,385	1,310	41,206	8,022	4,864	4,327	17,213
1973	22,547	19,275	1,466	43,288	8,295	5,085	4,649	18,029
1974	24,067	20,897	2,130	47,094	9,157	5,099	5,083	19,339

Source: Commercial Fertilizers, Statistical Reporting Service, U.S. Dept. of Agriculture.

Nitrogen materials consumed, including anhydrous ammonia, ammonium nitrate, nitrogen solutions, and urea, increased 66 percent during 1966-74, from 8.8 million to 14.6 million tons (table 16). Increased consumption has been, in part, responsible for the significant increase in use of barges by agriculture, because it has permitted large yield increases on land close to river shipping points.

Table 16--Total fertilizer consumed, by kinds, United States, 1966-74

Year	Nitrogen materials	Phosphate rock	Superphosphate all grades	Ammonium phosphate
		1,000 tons		
1966	8,779	493	1,372	783
1967	9,684	311	1,371	781
1968	10,476	256	1,487	804
1969	10,889	204	1,659	752
1970	11,898	170	1,517	644
1971	12,912	122	1,496	605
1972	12,833	71	1,480	607
1973	13,308	45	1,376	710
1974	14,551	37	1,378	756

Source: Commercial Fertilizers, Statistical Reporting Service, U.S. Dept. of Agriculture.

Consumption of phosphate rock dropped more than 90 percent during 1966-74, while barge traffic shipments more than doubled. Instead of being utilized as a fertilizer in its raw form, most phosphate rock is now shipped to fertilizer plants upstream, where it is converted to phosphoric acid, superphosphate, and other phosphatic compounds.

Of the phosphatic chemicals that travel by barge, superphosphate and ammonium phosphate are the most common (14, III-G. 11). Superphosphate consumption increased slightly during 1966-69 but then dropped off, and 1974 consumption was at about the 1966 level (table 16). Ammonium phosphate consumption also peaked in the late 1960's; by 1974, consumption had dropped to about 3 percent below 1966. The overall drop in consumption of these two fertilizers contributed to the 65 percent decrease in barge traffic (table 11).

Many of the Midwest grain producing States were the major domestic consumers of nitrogen materials. Anhydrous ammonia and nitrogen solutions accounted for almost 60 percent of total nitrogen materials consumed in 1974 (11, pp. 5, 6). The leading States in anhydrous ammonia consumption were Iowa, Illinois, Nebraska, Texas, and Kansas. Heavy users of nitrogen solutions were Illinois, Georgia, North Carolina, Nebraska, and Indiana.

Superphosphate consumption in 1974 was concentrated in Illinois, Iowa, Minnesota, and Ohio, with these States accounting for almost 50 percent of total U.S. superphosphate consumption.

Relative Costs to Shippers

Inland waterway carriers typically have had a relative cost advantage over most competing modes in transporting liquid and bulk commodities. Comparison of waterway

industry estimates of modal costs of transporting total domestic freight reveals striking differences (table 17).

However, ton-mile costs of transporting grain by truck and rail are significantly lower than the average for all U.S. domestic freight. This is demonstrated in a recent study of rail, barge, truck, and intermodal costs of transporting grain from points in Iowa to the Gulf of New Orleans, Louisiana (13, pp. 28-29).

Estimated 1974 costs of shipping corn by barge from Dubuque, Iowa, to the Gulf and returning empty were $7.15 per ton, or $0.0025 per ton-mile. A competitive rail movement estimated on a single-car hopper basis was $11.06 per ton, or approximately $0.0038 per ton-mile. Costs of shipping corn on an 85-car continuous train lowered per-ton costs to $7.88 and per-ton-mile costs to $0.0027. The unit train concept was introduced in recent years by railroads to compete with barge movements to the Gulf ports.

Much of the grain transported to intermediate points or markets is by tractor-trailer. Distances usually range up to 200 miles one way. Costs vary by length of haul and annual total miles traveled. In 1974, per-ton-mile costs ranged from $0.0312 to $0.0594 (13, pp. 368-391).

Several factors may account for differences among the estimated costs of the competing modes. Technological advances in barge capacity, increases in towboat horsepower, increases in channel depth, and larger locks have increased the efficiency of water carriers in transporting larger volumes of bulk and liquid commodities. Average length of haul by barge between a given origin and destination is longer than by either rail or truck, thus partially offsetting more favorable ton-mile costs of barges. Distance is an important factor for trucks. Their high line-haul operating costs explain most of the wide disparity in ton-mile costs from those of the barges. In addition to their lower operating costs, water carriers experience little or no facility maintenance or operating costs or capital investments for the rights-or-way they use.

WATERWAY POLICY ISSUES IMPORTANT TO AGRICULTURE

User Charges

The Federal Government has financed construction, maintenance, and navigation projects on U.S. waterways since 1824. Total investment since the early 19th century through 1974 has been estimated at $8.3 billion. Of the total, an estimated $4.5 billion has been spent on inland waterways (7, p. 111).

The U.S. Army Corps of Engineers is responsible for administering these operations. The U.S. Coast Guard also provides navigation and safety enforcement services. In 1975, annual expenditures for shallow draft navigation projects and maintenance operations were about $350 million. Annual appropriations of the Coast Guard approached $70 million.

A long-standing issue has been whether inland waterway users and beneficiaries should pay user charges to share in the costs of service provided by public investments.

In a statement on policy priorities, the Department of Transportation (DOT) contends that inequities exist in present subsidy practices between inland waterways and competing modes. DOT states that although it is still necessary for waterways to receive Federal subsidies for nonnavigation benefits, the navigation portion of the costs should be borne by the beneficiaries in the form of user charges (12, p. 9).

Railroads state that Federal subsidies have given competing modes, especially trucks and water carriers, an economic advantage and were in part responsible for the

Table 17--Average U.S. domestic freight costs per ton and ton-mile, by mode, 1971-73

Mode	Average cost per ton			Average cost per ton-mile		
	1971	1972	1973	1971	1972	1973
	Dollars					
Truck	40.95	45.29	52.28	0.177	0.196	0.217
Rail	8.65	8.82	9.15	.017	.017	.017
Water 1/	2.77	2.59	2.53	.0041	.00384	.00389
Pipeline	1.85	1.87	1.80	.0034	.00334	.00325
Air	270.00	293.33	242.50	.232	.237	.242

1/ The revenue and ton-mile figures for water transportation includes inland, Great Lakes, and domestic deep sea.

Source: Upper Mississippi Waterway Association, The Economic Impact of Waterborne Transportation on the Upper Mississippi River Basin, St. Paul, Minn., July 1975.

railroads' significant drop in the share of intercity freight traffic in the last quarter-century (3, pp. 93-99). Railroads claim that there is a misallocation of resources, with traffic diverted to less efficient modes, because pricing is not based on full costs.

A hypothetical estimation of agriculture's stake in waterway user charges--based on net tons of agricultural products transported on major river systems and annual costs of maintaining and operating those rivers--is shown in table 18. By far the bulk of agricultural products is comprised of grains and soybeans, with the identified river segments accounting for 88 percent of the total transported on all inland waterways in 1975.

Using a proportioned allocation on a tonnage basis of the costs, agriculture's stake in the issue of charges is estimated at more than $39 million per year.

New capital expenditures are presently being incurred on the Arkansas and Warrior-Tombigbee River systems and are not included in the annual cost figures. If user charges were to be set at levels adequate to recover capital costs plus interest charges on the investments in these navigation improvements, agriculture's stake would be greater.

The type of recapture system used will also affect the overall level of fees charged for transporting commodities. For instance, user charges on a ton-mile basis would have a significant impact on agricultural commodities. In 1975, the average length of haul of grains on internal waterways was 1,129.8 miles per ton (8, p. 92). By comparison, the average length of haul for coal and coke was 293.7 miles per ton and that for iron ore, iron, and steel was 731.9 miles per ton. Agriculture's share of user charge fees would be substantially larger under this method. In addition, some river systems incur high maintenance and operating costs relative to the amount of traffic they generate. User charges designed to recapture investments rapidly would make rates prohibitive on some river segments.

Locks and Dam 26

Locks and Dam No. 26 is located below the Upper Mississippi and Illinois Waterway at Alton, Illinois. The locks have been in a deteriorated condition for several years. In early 1976, a guidewall collapsed in the main lock, causing a tieup of barges from both directions. Though now reopened, estimates of losses to the barges and towing industry were placed at $250,000 a day (5, p. 10).

The U.S. Army Corps of Engineers has recommended construction of a 1,200-foot lock to replace the existing 600-foot and auxiliary 360-foot locks. Project costs were set at $390 million and construction time was estimated at 8-11 years. However, the plan is opposed by railroads and environmentalists. Congressional hearings have been held to decide whether the existing facilities should be repaired or if construction on the proposed lock should commence. One alternative proposal would block construction of a new lock and dam until an economic and environmental impact study is completed and assessed.

Presently, about 50 million tons of cargo a year move through the locks (5, p. 10). It is estimated that maximum traffic will reach the capacity of 73 million tons by 1982 (5, p. 11).

All through-water traffic between the Upper Mississippi River (Minnesota, Wisconsin, Iowa, and Illinois) and the Illinois Waterway and the Lower Mississippi River and its tributaries must pass through Locks and Dam 26. In 1970, 14.8 million tons of grains

Table 18--Annual volume of agricultural products and 1975 expenditures, major river systems, 1975 traffic base

River system	Annual cost 1/	Net tons 1/	Cost/ ton 2/	Grains and Soybeans		Fertilizer and materials		Total agricultural products	
				Tons 1/	Cost 3/	Tons 1/	Cost 3/	Tons 4/	Cost 4/
	$1,000	1,000	Dol.	1,000	$1,000	1,000	$1,000	1,000	$1,000
Upper Mississippi (Minneapolis, MN, to mouth of Missouri River)	17,341.0	27,140.8	0.639	11,364.1	7,260.8	109.4	69.9	11,473.5	7,330.7
Middle Mississippi (mouth of Missouri River to mouth of Ohio River)	12,422.9	6,176.1	2.011	686.7	1,381.3	80.6	162.0	767.3	1,543.3
Lower Mississippi (mouth of Ohio River to mouth of Posses)	12,138.5	47,305.2	0.257	2,912.6	747.4	4,759.6	1,221.3	7,672.2	1,968.7
Arkansas 5/	11,703.2	591.5	19.786	348.2	6,889.5	6.8	134.5	355.0	7,024.0
Ohio	18,088.6	32,508.8	0.556	2,562.7	1,426.0	154.7	88.1	2,717.4	1,514.1
Tennessee	2,907.0	5,591.5	0.520	71.2	37.0	108.8	56.6	180.0	93.6
Illinois	9,246.5	19,671.6	0.470	12,430.4	5,842.8	28.2	13.2	12,458.6	5,856.0
Missouri	12,881.5	894.8	14.396	827.7	11,915.9	63.5	914.7	891.2	12,830.6
Warrior-Tombigbee-Mobile 5/	14,079.2	10,555.7	1.334	330.7	441.2	3.1	4.1	333.8	445.3
Columbia-Snake	2,794.0	11,895.5	0.235	2,746.3	879.9	48.9	11.5	2,795.2	891.4
All systems	113,602.4	162,331.5	0.700	34,280.6	36,821.8	5,363.6	2,675.9	39,644.2	39,497.7

1/ U.S. Army Corps of Engineers, Waterborne Commerce of the U.S. CY 1975, part 5, national summaries, Vicksburg, Miss.
2/ Computed by dividing column 1 by column 2.
3/ Computed by multiplying tons by column 3.
4/ Computed by adding appropriate column data, columns 4-7.
5/ Does not include new capital expenditures.

and soybeans originated from the Upper Mississippi and Illinois Rivers to destinations on the Lower Mississippi and Tennessee Rivers (table 7). The tonnage increased 47 percent to 21.7 million tons in 1974.

Conversely, in 1970, 1.8 million tons of fertilizer and fertilizer materials originated from Galveston Bay, Texas, and Baton Rouge-New Orleans, Louisiana, to points on the Upper Mississippi and Illinois Waterway. Movements increased to 2.3 million tons in 1974.

The combined total of grains, soybeans, and fertilizer that moved through the locks in 1974 was 24 million tons, or 48 percent of the total traffic handled at the facility.

PROSPECTS FOR THE FUTURE

Agricultural exports contribute to a positive U.S. balance of trade. Demand for them is brisk and is likely to remain so. Thus, it is probable that high exports of agricultural commodities will continue. In addition, total consumption of fertilizer is likely to remain high and perhaps increase as we strive to accomplish greater crop production. This will place continuing demands on the transportation system and for equipment to move these products.

Despite the sudden surge of grain exports in late 1972, barges did not initially transport much of the increase. Annual winter closing of rivers, excessive spring flooding in 1973, and lack of coordination between barge and ship arrivals at the ports appear to have caused barges not to share immediately in this traffic growth. Truck receipts at U.S. grain inspection areas rose 33 percent in 1972-73 from 1971-72 levels. Railroad receipts increased 43 percent.

Since 1973, however, inland water carriers have participated more actively in the transportation of grain for export markets. Inland barge shipments increased 63 percent from 1973 to 1976. Railcar loadings of grain declined 21 percent during the same period.

The more recent intermodal shift in grain movements appear to be the result of several factors. Barge rates have reportedly been more favorable than during 1972-73, improving the competitive position of water carriers. Overall, growth in barge equipment has also contributed to the increase. Also, continued development of intermodal coordination through truck-rail, truck-barge, and rail-barge combinations have provided a more economical and efficient movement of commodities. Thus, barges appear likely to continue to move large volumes of agricultural traffic.

However, the way in which recent waterway policy issues are decided will have an important bearing on the transportation of agricultural products. Implementation of a user charge system is likely to result in waterway carriers' increasing barge rates to offset these added costs. Depending on the type of recapture system used, the user fees might eliminate some agricultural movements on those river segments having high maintenance and operating costs. Ultimately, the greater share of these costs would be borne by producers in the form of lower bid prices received for agricultural commodities.

In addition, the extent of rehabilitation or replacement of Locks and Dam 26 to accomodate a projected traffic increase will directly affect agriculture, a heavy user of the lock facility.

Nonetheless, growth of agricultural traffic on inland waterways is expected to continue into the forseeable future.

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